

## XX.—On the Digestive Organs of Infusoria.

By M. F. DUJARDIN\*.

THE experiments of artificial coloration had led M. Ehrenberg to recognise in 1830 the existence of deglutition in many Infusoria; considering at that time as stomachs all the vesicles in which the colouring matter had lodged, this observer endeavoured to find out the mode of connexion of these stomachs with a mouth and anus. Deceived undoubtedly by some illusion, he thought he perceived a central tube, straight or variously curved, to which the stomachic vesicles were attached by still narrower tubes, like the berries of a bunch of grapes. He described and figured *Enchelys pupa* with a straight intestine, *Leucophra patula* with the intestine curved three times, and *Vorticella citrina* with the intestine forming almost a complete circle, and returning to open for excretion at the side of the mouth. In the Monads, on the contrary, he represented the stomachs as attached around the mouth by long pedicles, and not affixed to the intestine. Although in the text of his memoir he took care to state that the vesicles filled with a solid nutriment are spherical and appear to be isolated, because the intestine which unites them contracts and becomes transparent, yet his drawings, supposed to be made after nature, represent this intestine equally extended everywhere, and even filled with colouring matter in *Vorticella*, so that one was naturally led to think that these representations were ideal. It did not escape him that a vesicle was capable of dilating considerably so as to contain a very voluminous prey, and consequently he admitted that the intestine must have dilated equally in order to allow it to pass. He had not yet noticed the difference between the vesicles or the globules of the interior, but he then attached so much importance to the discovery which he thought to have made of the intestine of Infusoria, that he made it the basis of his classification, calling Polygastrica the true Infusoria in opposition to the Rotatoria which are monogastric, and which united by him under the same denomination furnished false analogies. He distinguished

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the *Anentera*, which, unfurnished with intestines like the Monads, have their pedicellated stomachs simply suspended around the mouth, and the *Enterodela* which possess an intestine.

These were divided into *Cyclocæla*, *Orthocæla*, and *Campylocæla*, according to whether the intestine formed a circle as in the *Vorticella*, straight as in *Enchelys*, or contorted as in the *Leucophræ*; but the author, to conform, he observes, to the received laws of zoology, immediately substituted for these divisions other sections established on external characters depending on the position of the intestine, i. e. on the position of the anus and mouth. He thus termed *Anopisthia* the *Cyclocæla* which have the two apertures united in front; *Enantiotreta* those with the two apertures opposite and situated at the extremities of the body, and which may be subdivided into *Orthocæla* and *Campylocæla*; *Allotreta* those having one of the apertures terminal, the other lateral; and lastly *Katotreta*, those in which both apertures are lateral or non-terminal. In his second memoir (1832), M. Ehrenberg, without adducing new facts in support of his opinion, developed further his first ideas. In his third memoir (1833) he figured in two new types *Chilodon cucullus* and *Stylonychia mitylus*, the intestine as large, if not larger than in the three preceding species, which seems to be in contradiction to the extreme contractability which would have concealed this organ from the persevering investigations of other observers. At the same time he began to establish a distinction between the vesicles which can be filled by the colouring matter, and those which, always containing a diaphanous fluid and generally more voluminous and less susceptible of sudden contractions, are considered by him to be the male organs of generation. Even in 1776 Spallanzani had mentioned in the *Paramæciæ* these latter vesicles, which in this species are stelliform, but had assigned respiratory functions to them. M. Ehrenberg, on the contrary, following up his ideas of the signification or analogies of these parts, has afforded himself a means of solving, in appearance, the difficulties presented by the explanation of the functions of all these inner vesicles.

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produced without any alteration the figures of five species, previously represented with an intestine much expanded, and has moreover added, as also showing this organ, the figure of *Trachelium ovum* already described in 1833 (third memoir), with a large sunk band in the centre, and whence proceed very thin ramifications, anastomosing, which truly has no relation to the primitively supposed intestine so contractile and so difficult to perceive. He has also figured an intestine more or less complete in several *Vorticellinæ*, and this intestine dilated uniformly in some is represented in the figure of one of them (*Epistylis plicatilis*) as being from time to time inflated, as if the stomachs, instead of being appended in raceme, were arranged one after the other. With respect to the figure of *Paramœcium Aurelia*, with a curved intestine, he himself remarks, that it is only an ideal figure. While declaring that it is only in seven species, four of which are *Vorticellinæ*, in which he has been able to distinguish plainly the intestine so as to be able to draw it\*; he enumerates among the four species in which he had been able to trace it only from the successive passage of the nutriment, precisely the two Infusoria given in 1830, as having been the first that exhibited the intestine to him; moreover he has placed by the side of his old figures of *Leucophra* some new ones which seem to contradict them†. It will also be noticed with what urgency the author recommends the *Vorticellinæ* for the verification of this important fact, and the tendency which he has always shown to neglect representing the intestine in those species which he had cited in his first memoir as having been the first in which he had noticed this organ; thus, the example of *Leucophra* loses a great part of its value by comparison with the new drawings, the *Paramœciæ* have furnished but an ideal figure, and the *Kolpodea* have never been represented by him with any intestine whatsoever.

Can the analogy of the *Rotatoria* or *Syntolides*, &c., be called in aid, as has been already done, to prove the existence of an intestine in Infusoria, in which it is not even possible

\* Die Infusionsthierchen, von Ehrenberg, 1838, p. 362.

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to indicate a trace? But, as I have before stated, the difference between the two types is so great that this analogy is one of the most imperfect; and while denying the existence of an intestine in the true *Infusoria*, I admit in the *Rotatoria* not only an intestine, but even true jaws, respiratory organs, glands and an ovary.

Can it be said, that it suffices to have demonstrated that the alimentary substances have penetrated from outwards into these vesicles, to conclude, first, that they are stomachs, and then that these stomachs must communicate with an intestine? for it would not be possible to conceive stomachs having no communication with the exterior. But that is precisely what might be contested; for this consequence is founded on a false analogy with higher animals, in which the stomach is always in continuation with the intestine. But before coming to direct proofs, we must examine one objection which was first advanced by M. Bory de St. Vincent in 1832, was reproduced in 1835 by Dr. Foeke, of Bremen\*, and has recently been again presented to M. Ehrenberg, by Prof. Rymer Jones, before the British Association at Newcastle. This objection, which I consider well-founded, rests on the inner motion of the globules or sacculi, which can in no way be reconciled with the hypothesis of an intestine connecting all these globules together, and which, on the contrary, proves their entire independence. As M. Bory observed, the intestines, the tubes of communication, did they exist, would soon become inextricably entangled, unless by supposing them to be indefinitely extensible, they would not allow of the globules moving about as they do in the interior.

To these objections, founded on the displacement of the pretended stomachs in the interior of the Infusoria, M. Ehrenberg answers in his great work, that this motion is merely an apparent displacement, analogous to that of the small painted

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to indicate a trace? But, as I have before stated, the difference between the two types is so great that this analogy is one of the most imperfect; and while denying the existence of an intestine in the true *Infusoria*, I admit in the *Rotatoria* not only an intestine, but even true jaws, respiratory organs, glands and an ovary.

Can it be said, that it suffices to have demonstrated that the alimentary substances have penetrated from outwards into these vesicles, to conclude, first, that they are stomachs, and then that these stomachs must communicate with an intestine? for it would not be possible to conceive stomachs having no communication with the exterior. But that is precisely what might be contested; for this consequence is founded on a false analogy with higher animals, in which the stomach is always in continuation with the intestine. But before coming to direct proofs, we must examine one objection which was first advanced by M. Bory de St. Vincent in 1832, was reproduced in 1835 by Dr. Foeke, of Bremen\*, and has recently been again presented to M. Ehrenberg, by Prof. Rymer Jones, before the British Association at Newcastle. This objection, which I consider well-founded, rests on the inner motion of the globules or sacculi, which can in no way be reconciled with the hypothesis of an intestine connecting all these globules together, and which, on the contrary, proves their entire independence. As M. Bory observed, the intestines, the tubes of communication, did they exist, would soon become inextricably entangled, unless by supposing them to be indefinitely extensible, they would not allow of the globules moving about as they do in the interior.

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wooden figures which children put in motion upon the plaything consisting of an extensible arm, formed of splines crossed lozenge-wise. This inner displacement, which I thought in 1835 capable of explanation by the change of position in the Infusoria, by their rotation around the axis of their body, I have for two years considered as quite real, and it has been well seen and described by Prof. Rymer Jones\*. This observer, in declaring publicly at Newcastle that he never had been able to perceive the least trace of the central canal described by M. Ehrenberg, nor the branches which proceed therefrom to communicate with the sacculi, added that he was convinced from numerous observations, that in *Paramœcium Aurelia* and in allied species the minute gastric sacs (vesicles) move in a fixed direction all round the body of the animalcule;—a fact, which of itself, says the English observer, appears to be incompatible with the arrangement indicated by the Professor of Berlin. To this M. Ehrenberg, without recurring to the comparison to the child's toy, answered, that it is excessively difficult to see the central canal (the intestine), and that it was only in following the course of great masses of nutriment that he himself had been able to trace it.

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XXI.—*Descriptions of British Chalcidites.* By FRANCIS WALKER,  
F.L.S.

[Continued from vol. ii. p. 355.]

Sp. 45. *Cirrospilus* Murcia, Mas. *Cyaneus*, abdomen cupreum, antennæ nigro-piceæ, femora nigra, tibiæ piceæ, tarsi fusci, protibiæ fulvæ, alæ sublimpidæ.

Obscure cyaneus: oculi et ocelli rufi: antennæ nigro-piceæ; articuli 1<sup>us</sup> et 2<sup>us</sup> nigro-cyanei, hic apice piceus; abdomen cupreum: pedes fusci; coxæ nigrae; femora nigra; tibiæ piceæ; genua fulva; propedum femora apice fulva: alæ sublimpidæ; squamulæ piceæ; nervi pallide fusci. (Corp. long. lin.  $\frac{2}{3}$ ; alar. lin. 1.)

Found near London.

*Mas.* Corpus sublineare, nitens, scitissime squameum, parce hirtum: caput transversum, breve, convexum, juxta thoraci latum; vertex sat latus; frons abrupte declivis: oculi mediocres: antennæ filiformes corporis longitudine, pilis longis vestitæ; articulus 1<sup>us</sup> gracilis, sublinearis; 2<sup>us</sup> longicyathiformis; 3<sup>us</sup> brevis; 4<sup>us</sup>, 5<sup>us</sup> et 6<sup>us</sup> longi, lineares; clava longifusiformis, acuminata, articulo 6<sup>o</sup> duplo longior: thorax ovatus, convexus: prothorax brevissimus, supra vix conspicuus: mesothoracis scutum latitudine longius; parapsidum suturæ remotæ, bene determinatæ; scutellum breviconicum: metathorax transversus, mediocris: petiolus brevissimus: abdomen sublineare, planum,

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[Continued from vol. ii. p. 355.]

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Obscure cyaneus: oculi et ocelli rufi: antennæ nigro-piceæ; articuli 1<sup>us</sup> et 2<sup>us</sup> nigro-cyanei, hic apice piceus; abdomen cupreum: pedes fusci; coxæ nigrae; femora nigra; tibiæ piceæ; genua fulva; propedum femora apice fulva: alæ sublimpidæ; squamulæ piceæ; nervi pallide fusci. (Corp. long. lin.  $\frac{2}{3}$ ; alar. lin. 1.)

Found near London.

*Mas.* Corpus sublineare, nitens, scitissime squameum, parce hirtum: caput transversum, breve, convexum, juxta thoraci latum; vertex sat latus; frons abrupte declivis: oculi mediocres: antennæ filiformes corporis longitudine, pilis longis vestitæ; articulus 1<sup>us</sup> gracilis, sublinearis; 2<sup>us</sup> longicyathiformis; 3<sup>us</sup> brevis; 4<sup>us</sup>, 5<sup>us</sup> et 6<sup>us</sup> longi, lineares; clava longifusiformis, acuminata, articulo 6<sup>o</sup> duplo longior: thorax ovatus, convexus: prothorax brevissimus, supra vix conspicuus: mesothoracis scutum latitudine longius; parapsidum suturæ remotæ, bene determinatæ; scutellum breviconicum: metathorax transversus, mediocris: petiolus brevissimus: abdomen sublineare, planum,

\* Die Infusionsthierchen, 1838, p. 361.

M. Ehrenberg\* considers the separation and isolation of the stomachic vesicles as surprising only to those who have not observed earth worms cut into pieces. These pieces, he observes, let them be ever so minute, contract at each extremity in such a manner that but very little of the contained juices escape, and a similar effect is produced by the contraction of the isolated stomachs of the Infusoria. One fact undoubtedly is more forcible than all arguments; and I only regret that that of a vesicle containing fragments of *Oscillatoria* has not presented itself several times to the observer; for with respect to the alleged stomachs without contained aliments, even when they appear slightly coloured, the false comparison with the pieces of earth worms will not suffice to prove to me that the globules are not part of the gelatinous substance of the Infusoria, since I have frequently seen these globules coloured, either from their having a tinge of their own, or that this effect was the result of an optical illusion or of a phænomenon of accidental colours.

XXI.—*Descriptions of British Chalcidites.* By FRANCIS WALKER,  
F.L.S.

[Continued from vol. ii. p. 355.]

Sp. 45. *Cirrospilus* Murcia, Mas. *Cyaneus*, abdomen cupreum, antennæ nigro-piceæ, femora nigra, tibiæ piceæ, tarsi fusci, protibiæ fulvæ, alæ sublimpidæ.

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